

PROJECT IMPACT ANALYSIS

MINUTEMAN VILLAGE

700-800 MASSACHUSETTS AVENUE

IN

**BOXBOROUGH,
MASSACHUSETTS**

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MAY 2, 2019

6092

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1.0 Evaluation of Impact to Water Resources

This evaluation of impacts to water resources has been prepared pursuant to the requirements of Section 3.1 (12) of the Town of Boxborough Site Plan Approval Rules & Regulations which states:

“The applicant shall submit such materials on the measures proposed to prevent pollution of surface and ground water, erosion of soil, excessive runoff of precipitation, excessive raising or lowering of the water table, or flooding of other properties. The evaluation shall include the predicted impacts of the development on the aquifer, and if applicable, and compare the environmental impacts to the varying capacity of the aquifer.”

1.1 Prevention of Pollution of Surface Water

The project has been designed with a Stormwater Management System which conforms to the 10 standards of the Massachusetts Stormwater Management Policy (see Stormwater Management Report). These Standards have been adopted by the State pursuant to the authority granted by the Massachusetts Wetlands Protection Act and the Massachusetts Clean Water Act, both of which aim at the protection of surface waters of the Commonwealth.

The subject parcel contains land classified by the Massachusetts Wetlands Protection Act as “Bordering Vegetated Wetlands”. There are additional areas which are defined as “Wetlands” by the Boxborough Wetland Bylaw. These areas and areas, along with the associated 100-foot buffer zones, are protected by the Massachusetts Wetland Protection Act (WPA) and the Boxborough Wetland Bylaw (WB).

The proposed project has been designed to reduce and minimize impacts to these areas. There are two proposed areas of construction activity located within areas of WPA and WP jurisdiction.

Temporary Construction Access Road and utility Connection

As dictated by the Settlement agreement between the Town and the Applicant, the project includes the construction of a construction entrance from Massachusetts Avenue. This construction entrance will require the filling of bordering vegetated wetlands in the amount of 435 SF. As mentioned, the fill placed for the constriction road will be a temporary disturbance and will be removed upon completion of construction activities at the site.

The proposed Wetland Filling will be mitigated through the replication of the impacted wetland resource areas at a ratio of 2:1. Additionally, the gravel access road within the buffer zone will be removed and restored.

Underground utility lines (water lines and electrical conduits) will remain below the wetland areas, as the wells servicing the development area located on the northerly side of the wetland resource areas. Water lines will be placed within sleeves through the

buffer zone, so that replacement in the future can be accomplished without further impact to the wetland resources areas.

All the of the above referenced work has been designed in accordance with the provisions of the WPA and the WB and a Notice of Intent has been filing with the Conservation Commission.

Infiltration Basin #1

A small amount of grading is proposed within the 100-foot buffer zone in this location of the project. All impacts are located greater than 75-feet from the limit of the Bordering Vegetated Wetlands.

This work has been included in the Notice of Intent submitted to the Conservation Commission.

1.2 Prevention of Pollution of Groundwater

The project includes two primary sources of groundwater recharge: (1) Stormwater, and (2) Wastewater.

Stormwater Recharge

As referenced above, the project has been designed in accordance with the Massachusetts Stormwater Management Policy and its 10 standards. Standard # 3 states that:

“Loss of annual recharge to groundwater shall be eliminated or minimized through the use of infiltration measures including environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post-development site shall approximate the annual recharge from the pre-development conditions based on soil type. This standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook”

The site has been designed to infiltrate the required recharge volume. Recharge calculations are include in the Stormwater Report submitted for the project. In this case, infiltration is proposed within each of the two infiltration basins. Infiltrations basins are an approved stormwater BMP found within the Stormwater Management Handbook.

Additionally, the require stormwater operation and maintenance manual has been prepared. Implementation of the stormwater O&M will ensure functionality of the recharge systems through the life of the project.

Prior to infiltration, Standard # 4 of the Stormwater Policy requires that stormwater be treated for TSS. The standard requires 80% TSS removal prior to discharge. The project has been designed to meet this standard as documented in the Stormwater Report.

Wastewater Recharge

The proposed project includes the construction of 50 housing units which will be age restricted for people over the age of 55. 310 CMR 15.0 (Title 5) establishes the design wastewater flow for this use at 150 gallons per day (GPD)/unit. As such, the total wastewater design low for the project is 7,500 GPD.

An onsite sewage disposal system is proposed for the project in full compliance with 310 CMR 15.0 and local Boxborough Board of Health Regulations. As such, the required offsets to the groundwater table will be achieved for treatment of the effluent prior to discharge. The system will also require routine maintenance to ensure proper functionality of the system.

1.3 *Prevention of Erosion of Soil*

The project will involve alteration of greater than 1 Ac. Of land. As such, the construction activities at the site will require the preparation of a Stormwater Pollution Prevention Plan (SWPPP) as required by the EPA National Pollution Discharge Elimination System (NPDES).

The SWPPP will be prepared prior to construction and provides procedures for the prevention of soil erosion from the construction site. The SWPPP also establishes a required schedule for erosion control inspections and a protocol for the implementation of corrective action measures, should they be necessary.

The site plans also include an Erosion Control Plan which specifies BMP's to be used for the prevention of soil erosion. BMP's proposed include: silt fence/haybale barriers, temporary sedimentation basins, check dams, catch basin inlet protection, and specifications for stockpile managements, etc.

1.4 *Prevention of Excessive Runoff or Precipitation*

Standard # 2 of the Stormwater Management Policy states that:

“Stormwater management systems shall be designed so that post-developed peak discharge rates do not exceed pre-developed peak discharge rates.”

The project stormwater management system has been designed to comply with this require as documented in the Stormwater Report.

1.5 *Prevention of excessive raising or lowering of the groundwater table*

As referenced in section 1.2 above, Standard # 3 of the stormwater management states that the annual recharge of stormwater from the post developed site shall approximate the annual recharge from the pre-developed site. As stated, the project has been designed to meet this standard.

Additionally, the proposed wells to serve the project have been developed pursuant to the Department of Environmental Protection (DEP) Policies and Guidelines for Public Water Supply Systems”. The DEP approved the proposed well locations through the BRP WS 3

permitting process. As such, procedures for the flow testing and acquire tests all meet the DEP requirements, which aim to protect groundwater levels in the area.

1.6 Prevention of Flooding of other properties

As referenced in Section 1.4 above, the project stormwater management system has been designed such that the post-developed offsite peak discharge will be less than the pre-developed site. This has been achieved through the design of swales in the backs of the units, a stormwater drainage system in the proposed roadway, and the design of stormwater infiltration basins which, in addition to infiltrating the required recharge volume, will also act to slow the release of stormwater prior to discharge.

2.0 Evaluation of Impact on Landscape

This evaluation of impacts to the landscape has been prepared pursuant to the requirements of Section 3.1 (13) of the Town of Boxborough Site Plan Approval Rules & Regulations which states:

“The applicant shall submit an explanation, with sketch as needed, of design features intended to integrate the proposed new buildings, structures and plantings into the existing landscape to preserve and enhance existing aesthetic assets of the site, to screen objectional features from neighbors and public areas.”

1.1 Integration of proposed buildings into the existing landscape

The project has been designed to preserve as much of the existing vegetation of the site as possible. This has been achieved by clustering the units around a loop road and cul-de-sac configuration. As such, much of the vegetation on the site will be preserved.

Additionally, the units have been placed as far from the property line as possible. This will allow for the preservation of existing vegetation between the limit of work and abutting properties. The proposed units have been designed to look similar to a cape style home with a lower ridge height than a colonial type style.

The site grading has been designed to minimize the required cuts and fills. Slopes, (particularly those behind the units), will be revegetated to so that they blend into the existing vegetation on the property.

1.2 Aesthetics of the site

The site plan includes a Landscaping Plan which has been designed to enhance the aesthetics of the developed site. The landscape plans include street trees, shrubs, ornamental grasses, etc. that are common to the New England landscape.

Native plantings have been selected and placed throughout the project to enhance to visual appeal of the project. This has been done for the benefit of both the proposed units and the abutting structures.

1.3 Screening

As referenced above, the areas with proposed clearing in close proximity to the property line will be restored with new plantings. The goal of these plantings will be to fill in any gaps in the understory created from the clearing to provide a buffer to abutting properties.

Additionally, the proposed entrance to the project will be landscaped to soften the visual appearance of the proposed entrance drive. This will be accomplished through the planting of street trees and shrubs as depicted on the landscaping plans. The proposed sign for the development will be located in the vicinity of the proposed clubhouse, and not adjacent to Stow Road.

3.0 Evaluation of Traffic Impacts

This evaluation of impacts to traffic has been prepared pursuant to the requirements of Section 3.1 (14) of the Town of Boxborough Site Plan Approval Rules & Regulations which states:

“The applicant shall submit an evaluation of the development’s impact on the existing traffic network. The evaluation shall include: (a) the projected number of vehicle trips to enter and depart the site shall be estimated for an average day and peak hours, (b) the projected traffic flow patterns for both vehicular and pedestrian access, including vehicular movements at all intersections likely to be affected by the proposed development, (c) the impact of traffic upon existing streets in relation to levels of service and road capacities, and (d) the proposed mitigating measures”

3.1 *Projected number of vehicle trips*

The proposed includes the construction of 50 housing units (25 duplex units) which will be age restricted for people over the age of 55 years of age. The “Institute of Transportation Engineers (ITE) Trip General Manuals, 10th editions, Volume 2” defines this under land use code 252 “Senior Adult Housing Attached” which is described as:

“Senior adult housing consists of attached independent living developments, including retirements communities, age restricted housing, and active adult communities. These developments may include limited social or recreational service. However, they generally lack centralized dining and onsite medical facilities. Residents in these communities live independently, are typically active (requiring little to no medical supervision) and may or may not be retired.”

Average Weekday Vehicle Trips

The ITE manual projects the total average number of vehicle trips from a development with 50 units to be 176 trips (88 exiting and 88 entering). (see appendix A for supplemental information).

Average Weekend Day Vehicle Trips

The average daily traffic on Saturday is projected to be 140 (70 exiting, 70 entering).

The average daily traffic on Sunday is projected to be 146 trips (73 exiting, 73 entering)

Peak Weekday Hour Vehicle Trips

During the peak hour in the morning, which typically occurs sometime between 7am and 9 am, the number of vehicle trips is projected to be 10 tips. The typical distribution during this hour is 35% entering with 65% exiting which equates to ~ 4 trips entering and 7 trips exiting [fractions have been rounded up].

During the peak hour in the evening, which is typically occurs sometime between 4pm and 6pm, the number of vehicle trips is projected to be 15 trips. The typical distribution

during this hour is 55% entering with 45% exiting which equates to 9 trips entering and 7 trips exiting [fractions have been rounded up].

The maximum peak hour condition (evening weekday) at 15 vehicle trips, equates to 1 vehicle trips every 4 minutes on Stow Road.

Peak Weekend Hour Vehicle Trips

During the peak hour on Saturday, the number of vehicle trips is projected to be 16 trips. The typical distribution during this hour is 62% entering with 38% exiting which equates to 10 trips entering and 6 trips exiting.

During the peak hour on Sunday, the number of vehicle trips is projected to be 20 trips. The typical distribution during this hour is 64% entering with 36% exiting which equates to 13 trips entering and 7 trips exiting.

The maximum peak hour condition (Sunday) at 20 vehicle trips, equates to 1 vehicle trips every 3 minutes on Stow Road.

3.2 *Projected traffic flow patterns*

Vehicular Traffic Flow Patterns

It is projected that most of the traffic accessing the site will utilize the Massachusetts Avenue intersection. Due to the low volume of vehicle trips generated during the peak weekday hour (15 trips during the evening weekday peak hour) it is not expected that the vehicle trips from the site will have an impact on this intersection.

The intersection Stow Road/Burroughs Rd intersection will likely receive a fraction of the vehicles trips entering and exiting the site. Using the conservation assumption that all 15 vehicle trips utilize this intersection, it is not expected that this low volume will have a measurable impact for the level of service at the intersection.

Pedestrian Traffic Flow Patterns

The project includes the construction of sidewalks along the proposed roads. These walkways will be 5-feet in width and are designed to provide safe pedestrian access from each dwelling unit to the proposed clubhouse facility and to the community gardens located at the end of the cul-de-sac. The walkways will also provide connectivity of the various visitor parking spaces to each unit.

Additionally, a sidewalk connection from Sherri's Meadows to Massachusetts Ave is proposed. This will allow for safe pedestrian traffic from both the Sherri's Meadow and Minuteman Village developments to the Mass Ave/Stow Road intersection, where crosswalks already exist.

3.3 *Site Distance*

The available site distance has been measured at the existing Sherri's Meadow/Stow Road intersection. The sight distances are as follows:

Looking North – 431-feet

Looking South – 289-feet

These distances exceed the required “Stopping Distance” (AASHTO “A Policy on Geometric Design of Highways and Streets, 6th edition, Table 3-1) and the “Decision Sight Distance” required to stop on a rural road (AASHTO “A Policy on Geometric Design of Highways and Streets, 6th edition, Table 3-3). Those distances are as follows:

Stopping Sight Distance = 200-feet

Decision Sight Distance = 220-feet

(See Appendix B for supplemental information).

Appendix A – ITE Information

Senior Adult Housing - Attached (252)

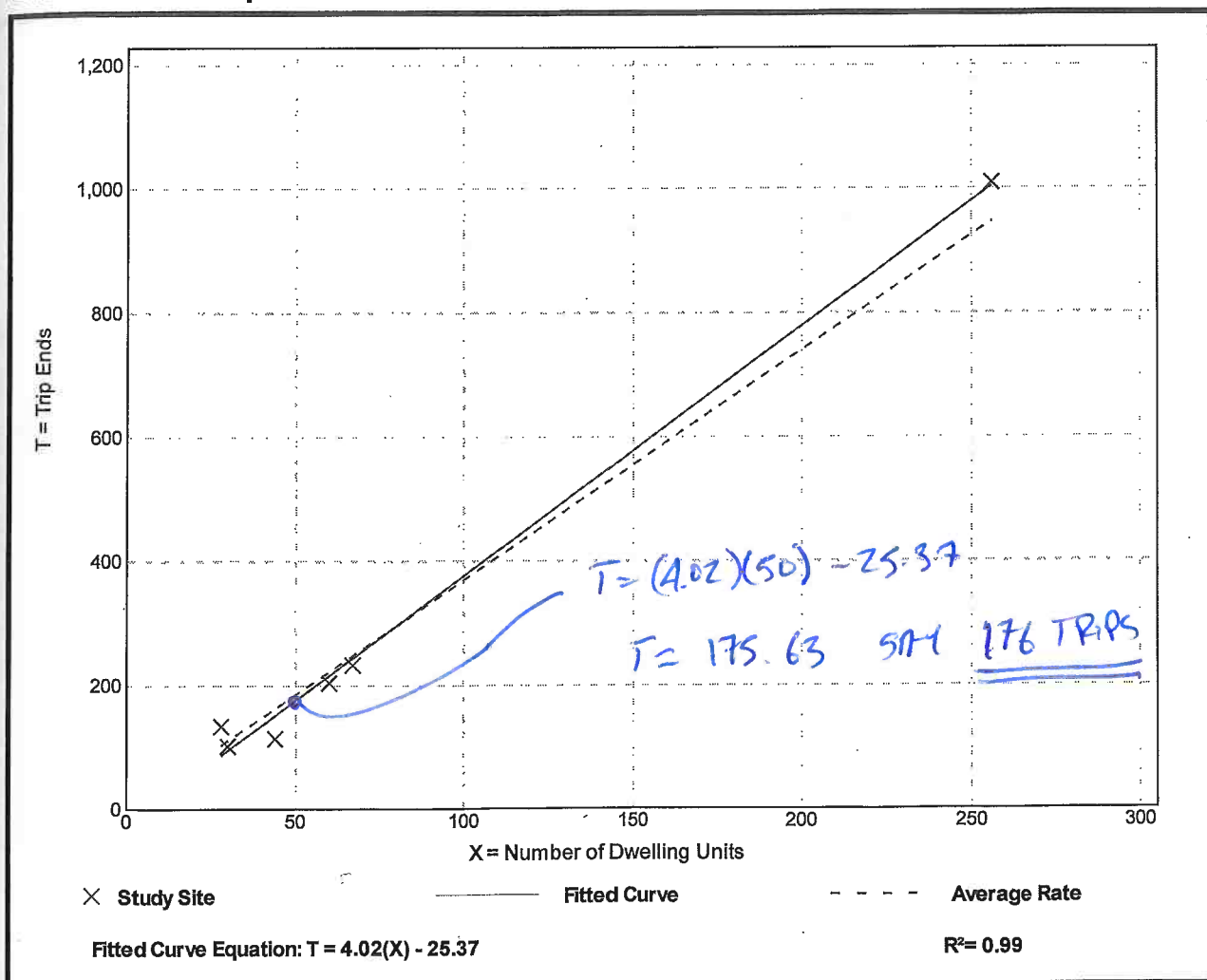
Vehicle Trip Ends vs: Dwelling Units
On a: Weekday

Setting/Location: General Urban/Suburban
Number of Studies: 6
Avg. Num. of Dwelling Units: 81
Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
3.70	2.59 - 4.79	0.53

Data Plot and Equation



Senior Adult Housing - Attached (252)

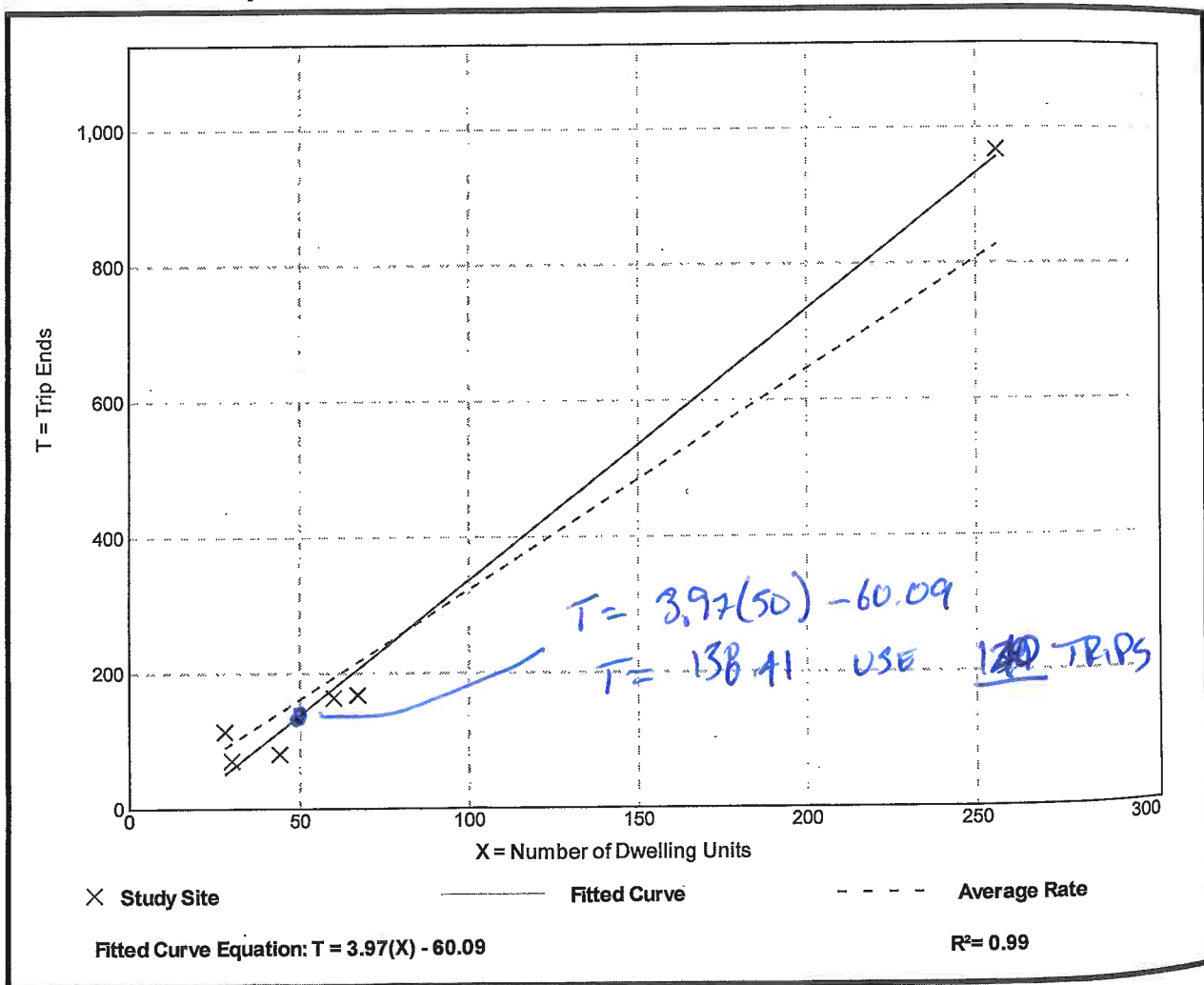
Vehicle Trip Ends vs: Dwelling Units
On a: Saturday

Setting/Location: General Urban/Suburban
Number of Studies: 6
Avg. Num. of Dwelling Units: 81
Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
3.23	1.84 - 4.07	0.79

Data Plot and Equation



Senior Adult Housing - Attached (252)

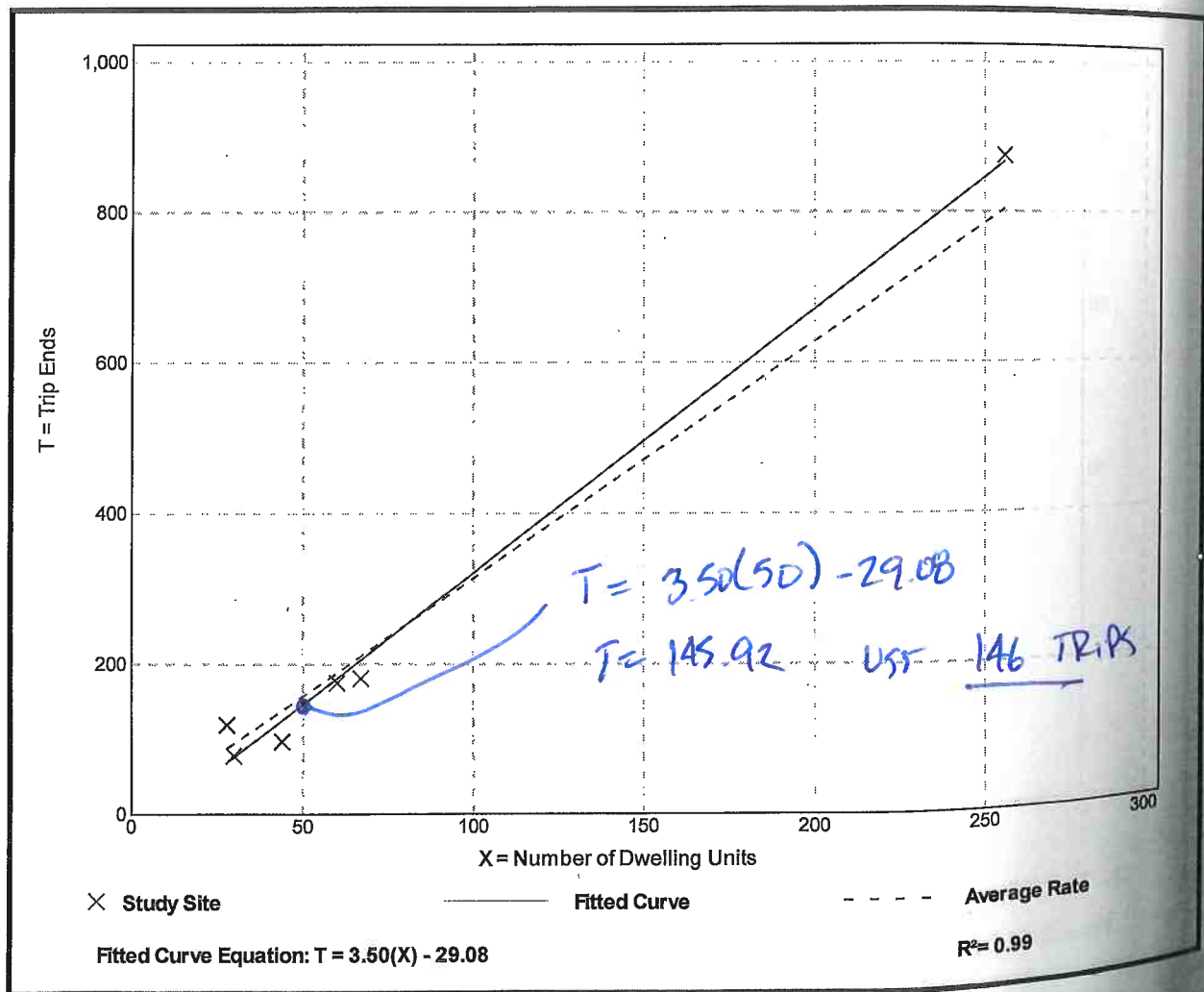
Vehicle Trip Ends vs: Dwelling Units
On a: Sunday

Setting/Location: General Urban/Suburban
Number of Studies: 6
Avg. Num. of Dwelling Units: 81
Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
3.14	2.20 - 4.25	0.54

Data Plot and Equation



Senior Adult Housing - Attached (252)

Vehicle Trip Ends vs: Dwelling Units

On a: Weekday,
Peak Hour of Adjacent Street Traffic,
One Hour Between 7 and 9 a.m.

Setting/Location: General Urban/Suburban

Number of Studies: 11

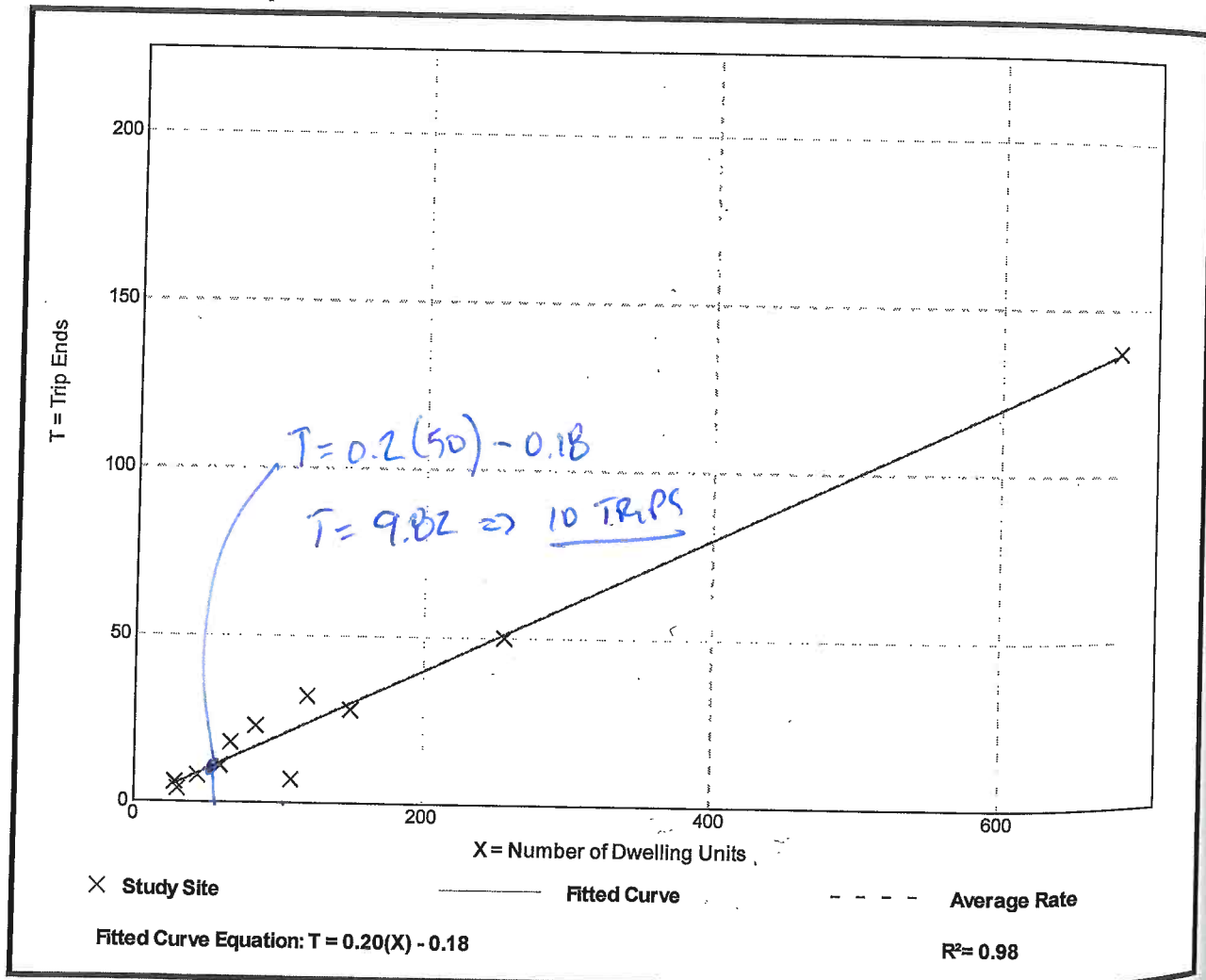
Avg. Num. of Dwelling Units: 148

Directional Distribution: 35% entering, 65% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.20	0.06 - 0.27	0.05

Data Plot and Equation



Senior Adult Housing - Attached (252)

Vehicle Trip Ends vs: Dwelling Units

On a: Weekday,
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.

Setting/Location: General Urban/Suburban

Number of Studies: 11

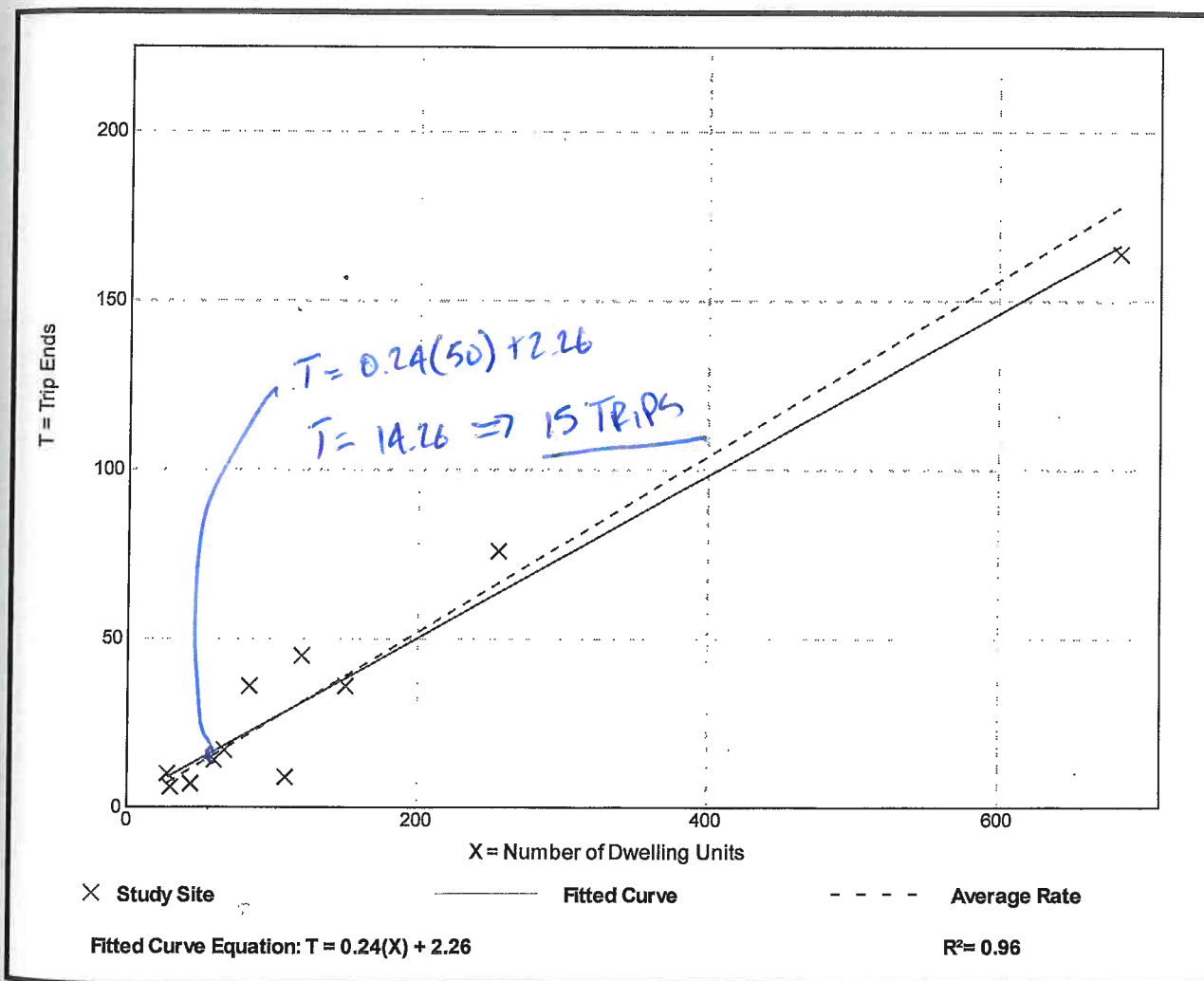
Avg. Num. of Dwelling Units: 148

Directional Distribution: 55% entering, 45% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.26	0.08 - 0.43	0.08

Data Plot and Equation



Senior Adult Housing - Attached (252)

Vehicle Trip Ends vs: Dwelling Units

On a: Saturday, Peak Hour of Generator

Setting/Location: General Urban/Suburban

Number of Studies: 7

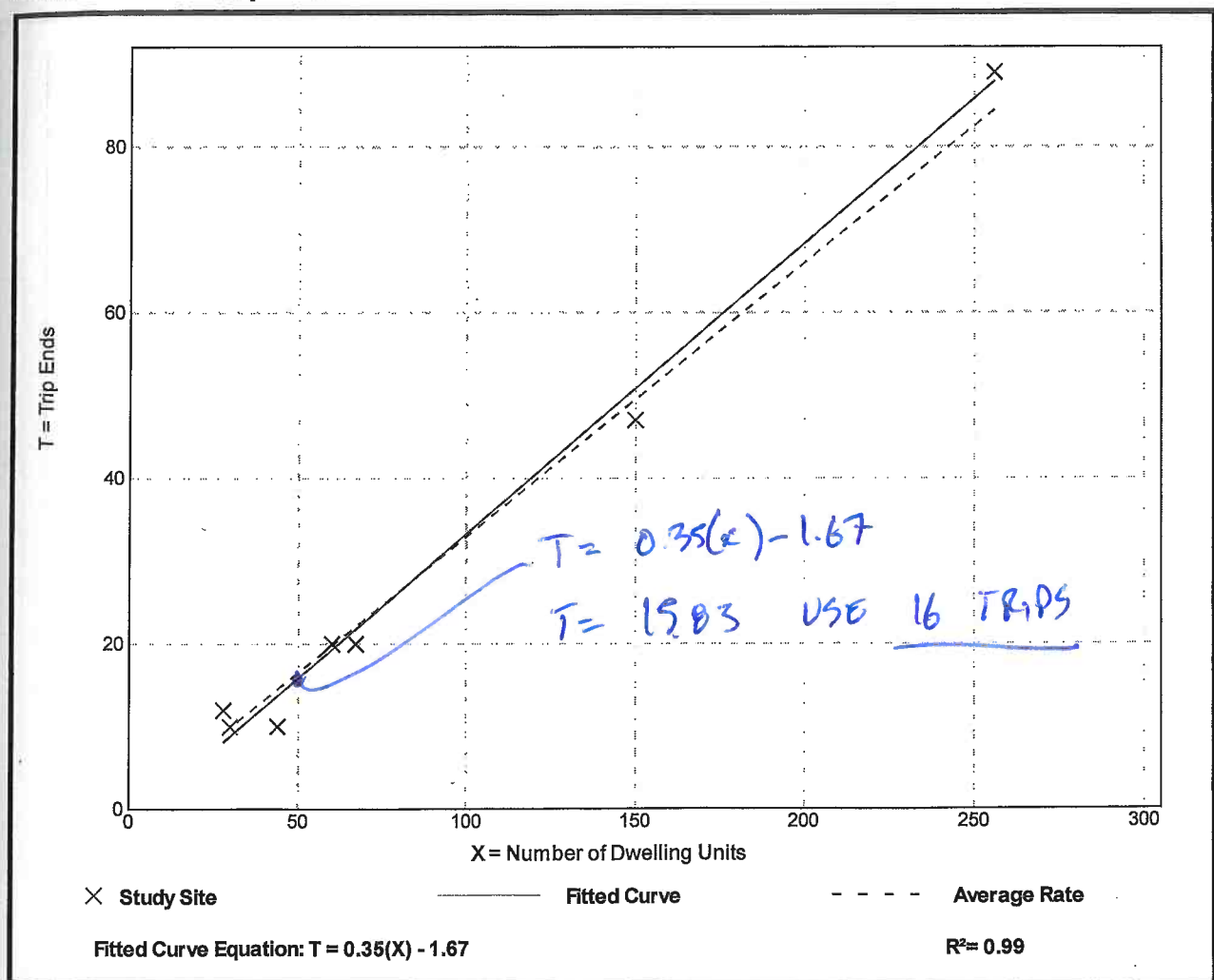
Avg. Num. of Dwelling Units: 91

Directional Distribution: 62% entering, 38% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.33	0.23 - 0.43	0.04

Data Plot and Equation



Senior Adult Housing - Attached (252)

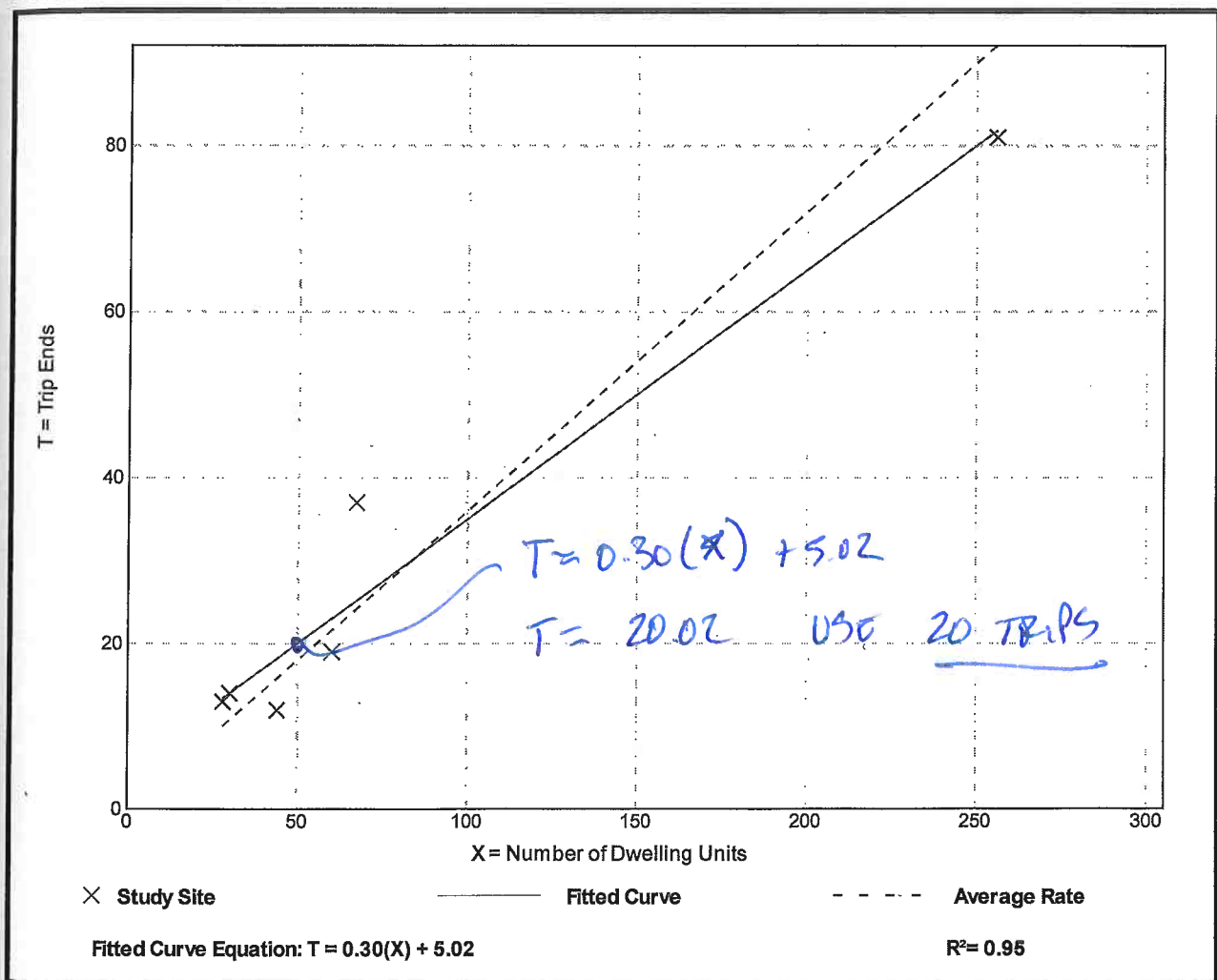
Vehicle Trip Ends vs: Dwelling Units
On a: Sunday, Peak Hour of Generator

Setting/Location: General Urban/Suburban
Number of Studies: 6
Avg. Num. of Dwelling Units: 81
Directional Distribution: 64% entering, 36% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.36	0.27 - 0.55	0.10

Data Plot and Equation



Appendix B – AASHTO Information

Table 3-1. Stopping Sight Distance on Level Roadways

Metric					U.S. Customary				
Design Speed (km/h)	Brake Reaction Distance (m)	Braking Distance on Level (m)	Stopping Sight Distance		Design Speed (mph)	Brake Reaction Distance (ft)	Braking Distance on Level (ft)	Stopping Sight Distance	
			Calculated (m)	Design (m)				Calculated (ft)	Design (ft)
20	13.9	4.6	18.5	20	15	55.1	21.6	76.7	80
30	20.9	10.3	31.2	35	20	73.5	38.4	111.9	115
40	27.8	18.4	46.2	50	25	91.9	60.0	151.9	155
50	34.8	28.7	63.5	65	30	110.3	86.4	196.7	200
60	41.7	41.3	83.0	85	35	128.6	117.6	246.2	250
70	48.7	56.2	104.9	105	40	147.0	153.6	300.6	305
80	55.6	73.4	129.0	130	45	165.4	194.4	359.8	360
90	62.6	92.9	155.5	160	50	183.8	240.0	423.8	425
100	69.5	114.7	184.2	185	55	202.1	290.3	492.4	495
110	76.5	138.8	215.3	220	60	220.5	345.5	566.0	570
120	83.4	165.2	248.6	250	65	238.9	405.5	644.4	645
130	90.4	193.8	284.2	285	70	257.3	470.3	727.6	730
					75	275.6	539.9	815.5	820
					80	294.0	614.3	908.3	910

Note: Brake reaction distance predicated on a time of 2.5 s; deceleration rate of 3.4 m/s² [11.2 ft/s²] used to determine calculated sight distance.

Design Values

The stopping sight distance is the sum of the distance traversed during the brake reaction time and the distance to brake the vehicle to a stop. The computed distances for various speeds at the assumed conditions on level roadways are shown in Table 3-1 and were developed from the following equation:

Metric	U.S. Customary
$SSD = 0.278Vt + 0.039 \frac{V^2}{a}$ <p>where:</p> <p>SSD = stopping sight distance, m</p> <p>V = design speed, km/h</p> <p>t = brake reaction time, 2.5 s</p> <p>a = deceleration rate, m/s²</p>	$SSD = 1.47Vt + 1.075 \frac{V^2}{a}$ <p>(3-2)</p> <p>where:</p> <p>SSD = stopping sight distance, ft</p> <p>V = design speed, mph</p> <p>t = brake reaction time, 2.5 s</p> <p>a = deceleration rate, ft/s²</p>

Stopping sight distances exceeding those shown in Table 3-1 should be used as the basis for design wherever practical. Use of longer stopping sight distances increases the margin for error for all drivers and, in particular, for those who operate at or near the design speed during wet pavement conditions. New pavements should have initially, and should retain, friction coefficients consistent with the deceleration rates used to develop Table 3-1.

Drivers need decision sight distances whenever there is likelihood for error in either information reception, decision making, or control actions (40). Examples of critical locations where these kinds of errors are likely to occur, and where it is desirable to provide decision sight distance include interchange and intersection locations where unusual or unexpected maneuvers are needed, changes in cross section such as toll plazas and lane drops, and areas of concentrated demand where there is apt to be "visual noise" from competing sources of information, such as roadway elements, traffic, traffic control devices, and advertising signs.

The decision sight distances in Table 3-3 may be used to (1) provide values for sight distances that may be appropriate at critical locations, and (2) serve as criteria in evaluating the suitability of the available sight distances at these locations. Because of the additional maneuvering space provided, decision sight distances should be considered at critical locations or critical decision points should be moved to locations where sufficient decision sight distance is available. If it is not practical to provide decision sight distance because of horizontal or vertical curvature or if relocation of decision points is not practical, special attention should be given to the use of suitable traffic control devices for providing advance warning of the conditions that are likely to be encountered.

Table 3-3. Decision Sight Distance

Metric						U.S. Customary					
Design Speed (km/h)	Decision Sight Distance (m)					Design Speed (mph)	Decision Sight Distance (ft)				
	Avoidance Maneuver						Avoidance Maneuver				
	A	B	C	D	E		A	B	C	D	E
50	70	155	145	170	195	30	220	490	450	535	620
60	95	195	170	205	235	35	275	590	525	625	720
70	115	325	200	235	275	40	330	690	600	715	825
80	140	280	230	270	315	45	395	800	675	800	930
90	170	325	270	315	360	50	465	910	750	890	1030
100	200	370	315	355	400	55	535	1030	865	980	1135
110	235	420	330	380	430	60	610	1150	990	1125	1280
120	265	470	360	415	470	65	695	1275	1050	1220	1365
130	305	525	390	450	510	70	780	1410	1105	1275	1445
						75	875	1545	1180	1365	1545
						80	970	1685	1260	1455	1650

Avoidance Maneuver A: Stop on rural road— $t = 3.0$ s

Avoidance Maneuver B: Stop on urban road— $t = 9.1$ s

Avoidance Maneuver C: Speed/path/direction change on rural road— t varies between 10.2 and 11.2 s

Avoidance Maneuver D: Speed/path/direction change on suburban road— t varies between 12.1 and 12.9 s

Avoidance Maneuver E: Speed/path/direction change on urban road— t varies between 14.0 and 14.5 s

Decision sight distance criteria that are applicable to most situations have been developed from empirical data. The decision sight distances vary depending on whether the location is on a rural or urban road and on the type of avoidance maneuver needed to negotiate the location properly. Table 3-3 shows decision sight distance values for various situations rounded for design. As can be seen in the table, shorter distances are generally needed for rural roads and for locations where a stop is the appropriate maneuver.